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RPI Adaptation Report

Version 1.0

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RPI Application Adaptation Data Guidelines

1. Introduction

This document is a guide to the compilation of adaptation data for the RPI Application. Adaptation of an RPI Application defines the reference path, one or more image paths, and one or more qualification regions. It also defines additional parameters that control and filter the displayed Aircraft Indicators. RPI will require adaptation to meet the airspace characteristics unique to each facility. Most of the adaptation is site specific however there are some adaptation items that are national standards.

1.1.   Purpose

The successful implementation of RPI is dependent upon the proper development of environmental and computer-human interface (CHI) adaptation data. This document provides the rules and best practice guidelines for compiling RPI adaptation to fit the specific STARS terminal airspace.

1.2.   Scope

The environmental and CHI adaptation data for the RPI application are addressed in this document. The rules and best practices for compiling adaptation data are presented in the form of a guide. This document is not a data dictionary nor does it provide a data base design.

1.3.   Intended Audience

The adaptation data specialist is the primary audience for this guide.

2. Adaptation Data

Adaptation data for ATC platforms can be divided into two broad categories; nation-wide, i.e., national, and facility-specific. Each broad adaptation category can be further divided into environmental and CHI. The following subsections provide guidance for defining environmental and CHI adaptation data for the RPI application. Determination of national versus facility-specific adaptation data is beyond the scope of this document.

2.1.   Environmental Adaptation Data Best-Practice Rules

The environmental data specifies the operational parameters for each RPI Application set.

2.1.1. RPI Application Set

The Automation System can host no less than 128 RPI Applications. The Automation System can group these RPI Applications into no less than 128 RPI Application Sets. Each RPI Application Set groups 2 or more RPI Applications. An Application Set can be enabled or disabled facility-wide. All RPI Applications encapsulated by the Application Set will be enabled or disabled in conjunction with the set.

2.1.1.1. RPI Application

Each RPI Application has its own unique environmental parameter values. An RPI Application can be enabled or disabled facility-wide independently of the Application Set within which it is encapsulated.

2.1.1.1.1. Qualification Region

There can be up to 10 Qualification Regions for each RPI Application. Each Qualification Region is a three-dimensional (3-D) volume that encompasses a portion of a Reference Path.

2.1.1.1.1.1. 3-D Geometry

The 3-D Geometry of the Qualification Region is a closed polygon of 3 but not more than 15 sides and made up of a sequence of WGS84 geodetic points that define a simple non-self-intersecting polygon.

The vertical dimension of the Qualification Region is specified in the Qualification Region Filters as an altitude interval, both floor and ceiling, in feet above mean sea level (MSL).

BEST-PRACTICE TIPS: The Qualification Region should be constructed to encompass a portion of the Reference Path such that the start point (initial fix) and end point (reference point) of the reference line is on the boundary of or outside of the qualification region. See Figure 1.
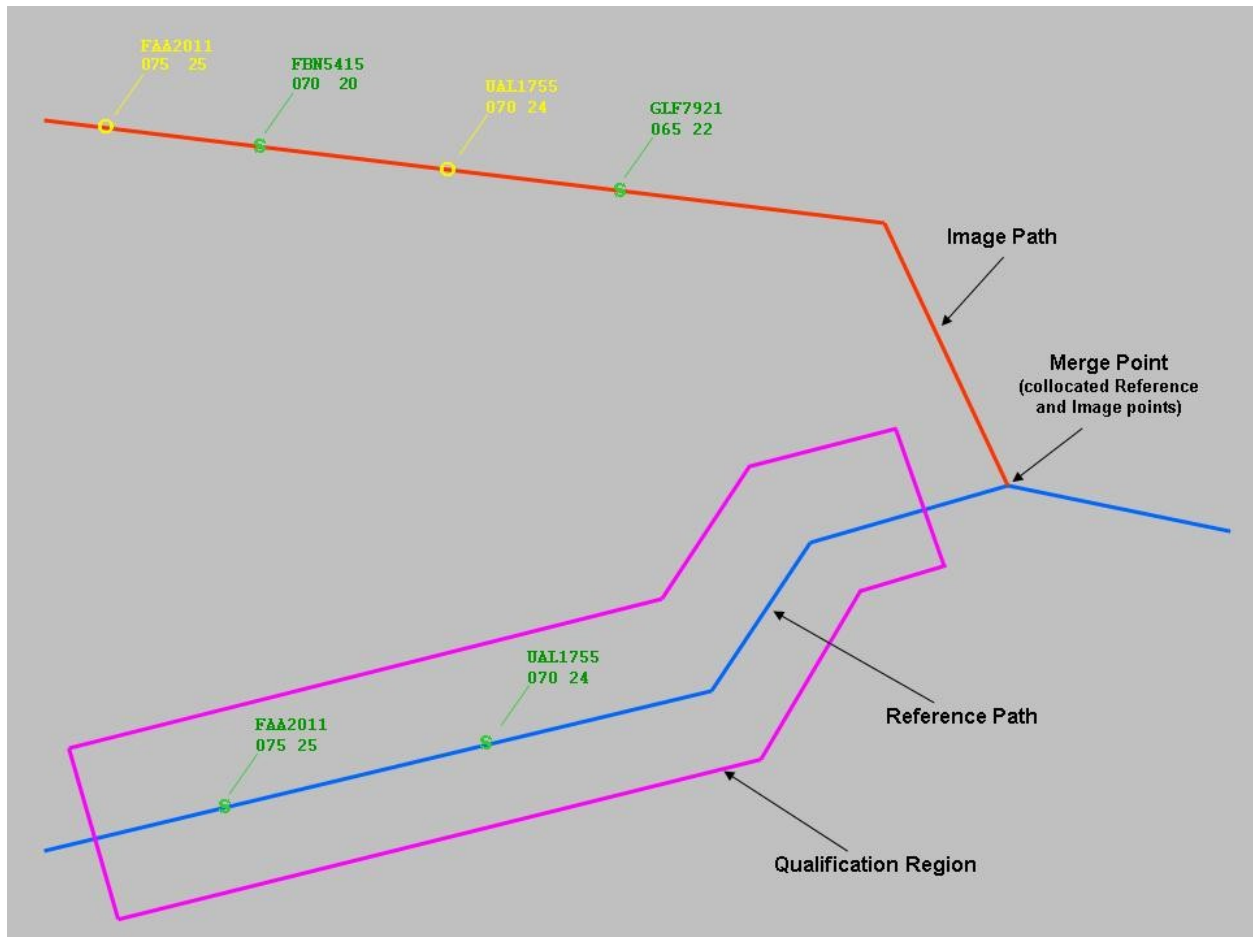
Figure 1: Example RPI Reference and Image Paths

2.1.1.1.2. Reference Path

There is no less than one Qualification Region per Reference Path.

BEST-PRACTIC TIPS: The Reference Path selected typically corresponds with the primary flow, i.e. the flow with more traffic and/or the one in which aircraft vectoring for sequencing is less common or desirable. Additionally, greater opportunities for aircraft sequencing are provided for Reference Paths that are farther away from the airport's final approach.

As indicated in the previous section, the Reference Path should begin and end either on the boundaries of the Qualification Region or outside of the Qualification Region. This ensures that an aircraft within the Qualification Region will be on or perpendicular to the Reference Path.

On a turn segment of the Reference Path the perpendicular distance on the inside of the turn to the Qualification Region from the turn segment will be less than the radius of the turn. See Figure 2.

Figure 2: Reference Path Qualification Region Limit

2.1.1.1.2.1. 3-D Geometry

Each Reference Path can be between 2 to 16, inclusive, WGS84 geodetic points. Each point must include an expected altitude and an expected airspeed.

The Reference Path often times corresponds to a Standard Terminal Arrival Route (STAR) that merges with one or more other STARs prior to the airport. The STAR may or may not be an RNAV/RNP STAR.

2.1.1.1.3. Image Path(s)

At least 1 and not more than 5 Image Paths may be defined for each Qualification Region.

BEST-PRACTICE TIPS: The Image Path selected typically corresponds with a secondary flow, i.e. the flow with less traffic and/or the one in which aircraft vectoring for sequencing is more common or desirable.

2.1.1.1.3.1. Mirror Imaging

Each Image Path definition includes a Mirror Imaging parameter of enabled or disabled. Figure 3 illustrates a situation in which mirror imaging is desirable.

Actual Aircraft – Offset to the right of the path

Actual Aircraft – Offset to the right of the path

Projected Indicator – Offset to the right of the path

Projected Indicator – Offset to the left of the path

Conventional projection does not give a good indication of where the actual aircraft and the projected indicator will converge

Mirror image projection properly indicates where the actual aircraft and the projected indicator will converge

Figure 3: Mirror Image Projection

2.1.1.1.3.2. 3-D Geometry

Each Image Path may be comprised of a sequence of between 2 to 16, inclusive, WGS84 geodetic points. Each point must include an expected altitude and an expected airspeed.

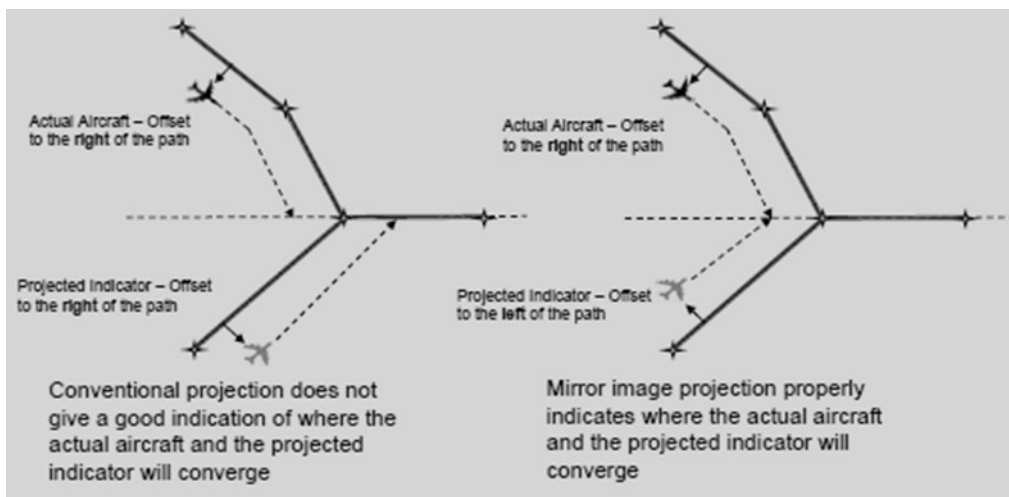On a turn segment of the Image Path the perpendicular distance on the inside of the turn to the Qualification Region from the portion of the Reference Path that projects onto the turn segment of the Image Path will be less than the radius of the turn. Figure 4 illustrates the Qualification Region limit for Image Paths.
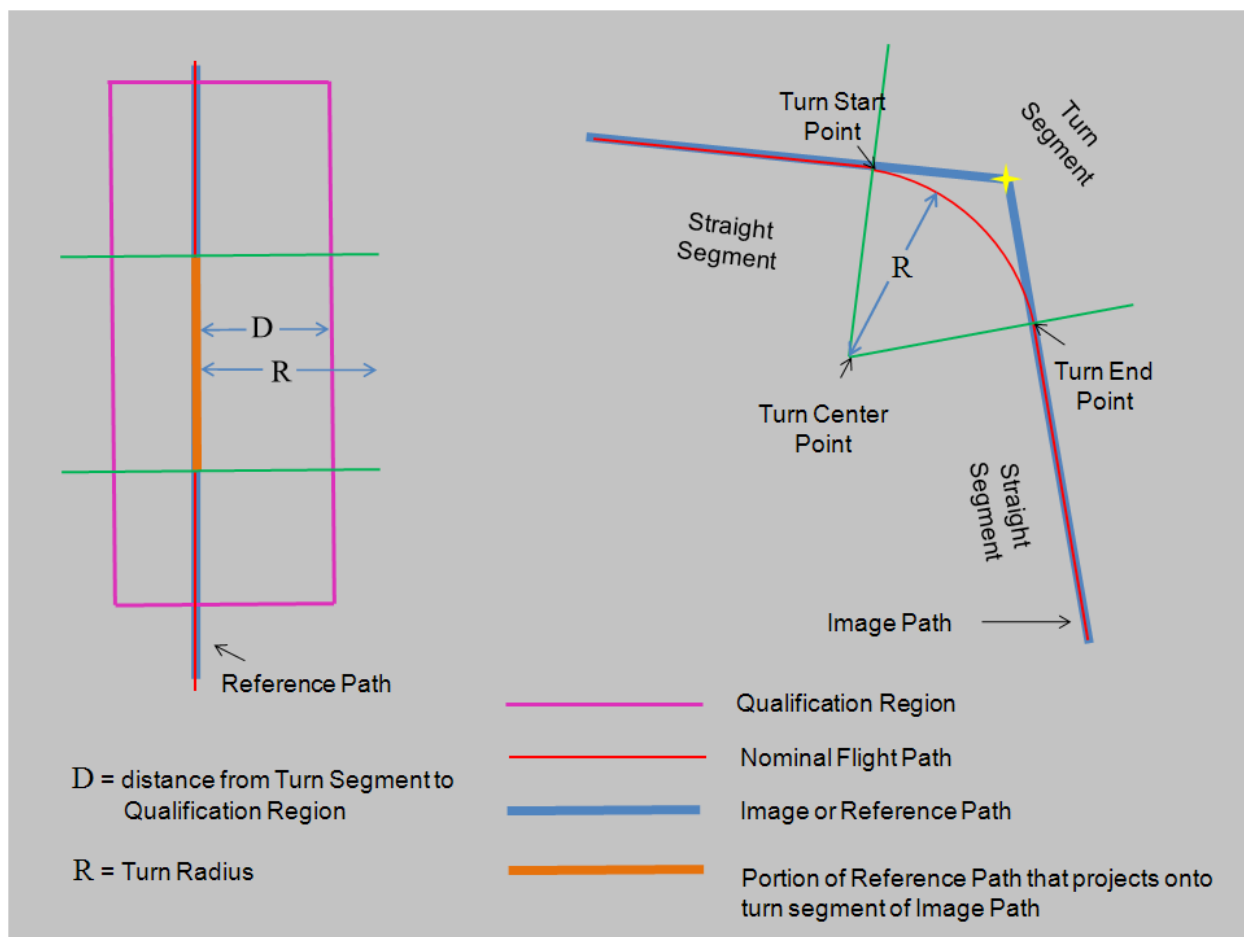
Figure 4: Image Path Qualification Region Limit

2.1.1.1.4. Filters

Each filter is capable of being enabled and disabled on a per Qualification Region basis.

2.1.1.1.4.1. Magnetic Heading

Magnetic Heading Filter is in the form of a beginning and ending range in degrees referenced to magnetic North.

2.1.1.1.4.2. Altitude Filter

The Input Aircraft will pass the Altitude Filter only if its altitude is within the altitude interval. The altitude filter has a floor and ceiling altitude specified as a range in feet above MSL.

In the absence of the aircraft's Mode-C altitude, adaptation must specify whether an input aircraft is considered to have qualified for the altitude filter.

2.1.1.1.4.3. Datablock Offset Filter

The Input Aircraft will pass the Datablock Offset Filter only if its Datablock Offset is equal to one of the Datablock Offset directions specified in the filter values. The Datablock Offset values are specified as North, Northeast, East, Southeast, South, Southwest, West, and Northwest.

2.1.1.1.4.4. Scratchpad Inclusion Filter

The Input Aircraft will pass the Scratchpad Inclusion Filter only if its scratchpad is equal to any of the values specified in the filter. The Scratchpad Inclusion Filter can contain up to 20 values.

2.1.1.1.4.5. Scratchpad Exclusion Filter

The Input Aircraft will pass the Scratchpad Exclusion Filter and be excluded from RPI processing only if its scratchpad is equal to any of the values specified in the filter. The Scratchpad Exclusion Filter can contain up to 20 values.

2.1.1.1.4.6. Entry Fix Inclusion Filter

The Input Aircraft will pass the Entry Fix Inclusion Filter only if its Entry Fix is equal to any of the values specified in the filter. The Entry Fix Inclusion Filter can contain up to 20 values.

2.1.1.1.4.7. Entry Fix Exclusion Filter

The Input Aircraft will pass the Entry Fix Exclusion Filter and be excluded from RPI processing only if its Entry Fix is equal to any of the values specified in the filter. The Entry Fix Exclusion Filter can contain up to 20 values.

2.1.1.1.4.8. Exit Fix Inclusion Filter

The Input Aircraft will pass the Exit Fix Inclusion Filter only if its Exit Fix is equal to any of the values specified in the filter. The Exit Fix Inclusion Filter can contain up to 20 values.

2.1.1.1.4.9. Exit Fix Exclusion Filter

The Input Aircraft will pass the Exit Fix Exclusion Filter and be excluded from RPI processing only if its Exit Fix is equal to any of the values specified in

the filter. The Exit Fix Exclusion Filter can contain up to 20 values.

2.1.1.1.4.10. Controller Symbol Inclusion Filter

The Input Aircraft will pass the Controller Symbol Inclusion Filter only if its Controller Symbol is equal to any of the values specified in the filter. The Controller Symbol Inclusion Filter can contain up to 20 values.

2.1.1.1.4.11. Controller Symbol Exclusion Filter

The Input Aircraft will pass the Controller Symbol Exclusion Filter and be excluded from RPI processing only if its Controller Symbol is equal to any of the values specified in the filter. The Controller Symbol Exclusion Filter can contain up to 20 values.

2.1.1.1.4.12. Filter Interdependencies

The following defines the coupling between certain pairs of filters.

2.1.1.1.4.12.1. Scratchpad Inclusion/Exclusion Filters

A Qualification Region can allow a Scratchpad Inclusion Filter to be enabled only if a Scratchpad Exclusion Filter is not enabled for that region. Likewise, a Scratchpad Exclusion Filter can only be enabled if a Scratchpad Inclusion Filter is not enabled.

2.1.1.1.4.12.2. Entry Fix Inclusion/Exclusion Filters

A Qualification Region can allow an Entry Fix Inclusion Filter to be enabled only if an Entry Fix Exclusion Filter is not enabled for that region. Likewise, an Entry Fix Exclusion Filter can only be enabled if an Entry Fix Inclusion Filter is not enabled.

2.1.1.1.4.12.3. Exit Fix Inclusion/Exclusion Filters

A Qualification Region can allow an Exit Fix Inclusion Filter to be enabled only if an Exit Fix Exclusion Filter is not enabled for that region. Likewise, an Exit Fix Exclusion Filter can only be enabled if an Exit Fix Inclusion Filter is not enabled.

2.1.1.1.4.12.4. Controller Symbol Inclusion/Exclusion Filters

A Qualification Region can allow a Controller Symbol Inclusion Filter to be enabled only if a Controller Symbol Exclusion Filter is not enabled for that region. Likewise, a Controller Symbol Exclusion Filter can only be enabled if a Controller Symbol Inclusion Filter is not enabled.

2.1.1.1.5. Initialized/Default Values

Parameters that can be enabled or disabled by controller or supervisory action must default to either enable or disable.

All Qualification filters must default to either none (no value) or a value set by the facility within which the RPI Application is meant to run.

2.2. Computer-Human Interface (CHI) Adaptation Data Best-Practice Rules

The CHI data specifies the display and keyboard parameters for each RPI Application set. For additional information about the FAA's standards for CHI, see the Recommended References Section.

2.2.1. RPI Application Display

The Automation System can display no more than 32 RPI Applications, Application Sets or combinations thereof in the selection menu per display.

2.2.1.1. RPI Application

The Automation System is capable of supporting no less than 16 active Applications per display. The graphical interface must only display Applications and Application Sets adapted for the area for the individual display.

2.2.1.1.1. Qualification Region

The Automation System has the capability to adapt the default setting for the display of Qualification Regions on a display, an Application, or an Application Set basis.

2.2.1.1.2. Image Path

The Automation System has the capability to adapt the default setting for the display of RPI Image Paths on and off on a per Application or Application Set basis.

2.2.1.1.3. Image Aircraft Data Block

The Aircraft Indicator default datablock display state is either Full or Limited (Partial).

2.2.1.1.3.1. Full/Limited

Each RPI Application includes an option to display either Aircraft Indicator full datablocks or Aircraft Indicator partial datablocks.

2.2.1.1.3.1.1. Field(s) and Timesharing

Individual fields and field timesharing in the Aircraft Indicator full and partial datablocks can be defined.

2.2.1.1.3.2. Color

Each individual RPI Application has the option to specify the color of the Aircraft Indicators and datablocks. The colors available are defined in adaptation.

2.2.1.1.3.3. Datablock Offset

The Datablock Offset can be specified for all current and future Aircraft Indicators for all Applications or Application Sets on a per display basis. The Datablock Offset directions are: N, NE, E, SE, S, SW, W, NW. The offset can also be adapted to be the same offset as the parent reference track.

2.2.1.1.4. Image Aircraft Indicator

2.2.1.1.4.1. Controller Symbol

Each RPI Application has the option to specify the controller symbol for Aircraft Indicators as no symbol or as any character or symbol available in the display font.

2.2.1.1.4.2. Leading/Trailing Extension

Each RPI Application has the option to display a leading or trailing indicator extension line in nautical miles for Aircraft Indicator.

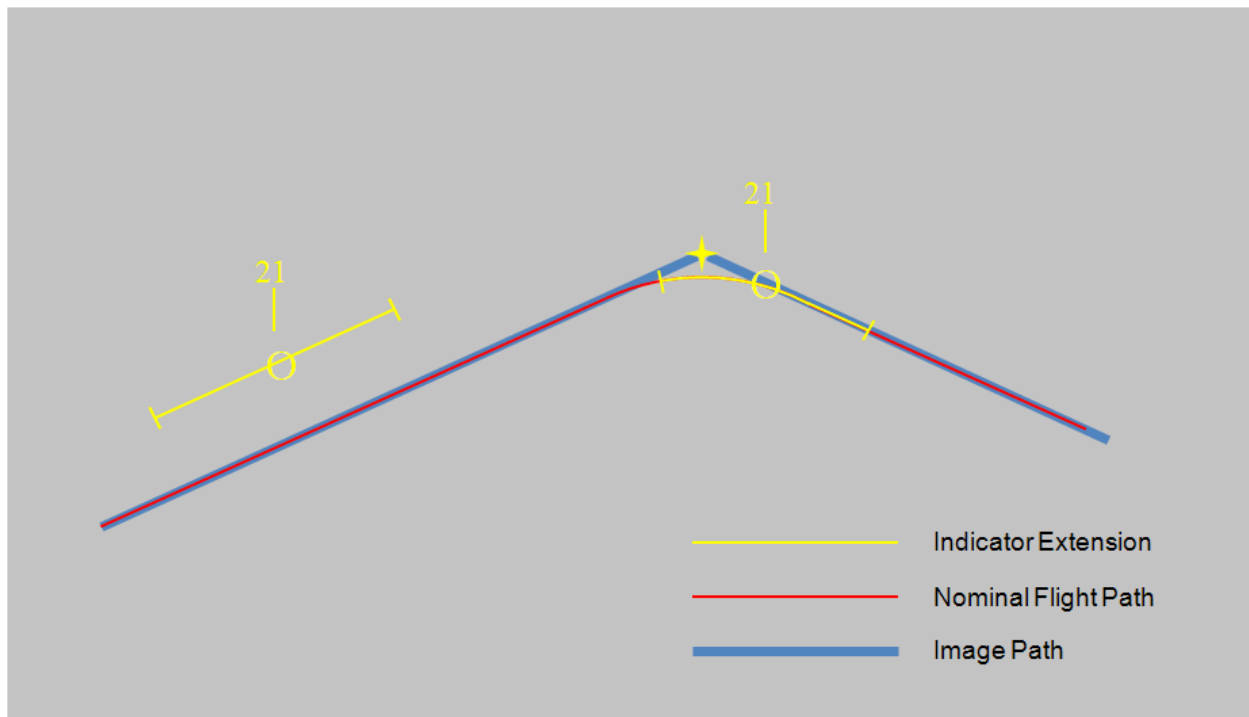Figure 5 illustrates leading and trailing indicator extensions.

Figure 5: Example of Indicator Extensions

2.2.1.1.4.3. Static Offset

Static Offset is an adapted distance associated with each Image Path. The terminal facility determines if Static Offset is required for RPI. If a Static Offset is specified for an Image Path, the offset distance is added to the Projection Distance when calculating the indicator location. Either positive or negative distances of up to and including 10 NM in increments of 0.01 NM can be defined.

2.2.1.1.4.4. Wake Offset

Wake Offset is an adapted distance associated with each aircraft type or class. The terminal facility determines if Wake Offset is required for RPI. If Wake Offset is specified for the Image Path and the aircraft type or class is provided, the Wake Offset

corresponding to that aircraft type or class is added to the Projection Distance when calculating the indicator location. Positive or negative distances of up to and including 10 NM in increments of 0.01 NM can be defined.

2.2.1.1.4.5. Mirror Imaging

Mirror Imaging can be enabled or disabled for the Image Path.

2.2.1.1.4.6. History Trails

The Automation System has the capability to adapt the default setting for the display of history trails for Aircraft Indicators.

2.2.1.1.5. Initialized/Default Values

All parameters that affect the visual or behavioral appearance of the controller displays must have a non-null default setting.

2.3.   Summary/Conclusions

The RPI Adaptation Data Guidelines provides rules and best-practices at specifying environmental and CHI adaptation data for the RPI Application. The best-practices highlighted in this guide are intended to present the collective experiences derived from certified professional controllers and front-line managers during RPI HITLS for defining and tailoring the RPI Application for a specific STARS terminal airspace.

3. Recommended References

1. HF-Std-001, Human Factors Design Standard for Acquisition of COTS Subsystems, NDIs, and Development systems, DOT/FAA/CT-03/05, May 2003
2. HF-Std-004, Requirements for a Human Factors Program, FAA, June 2009
3. Mil-Std-1472F, Human Engineering, August 1999.